PRELIMINARY INSTRUCTION MANUAL

MODEL 109

PULSE GENERATOR

DATAPULSE INCORPORATED
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Inglewood, California
ORegon 8-3983 ORchard 1-7713

ADDENDUM

MODEL 110,109 PULSE GENERATOR

INSTRUCTION MANUALS

EFFECTIVE DATE: April 7, 1965, per E.O. 733

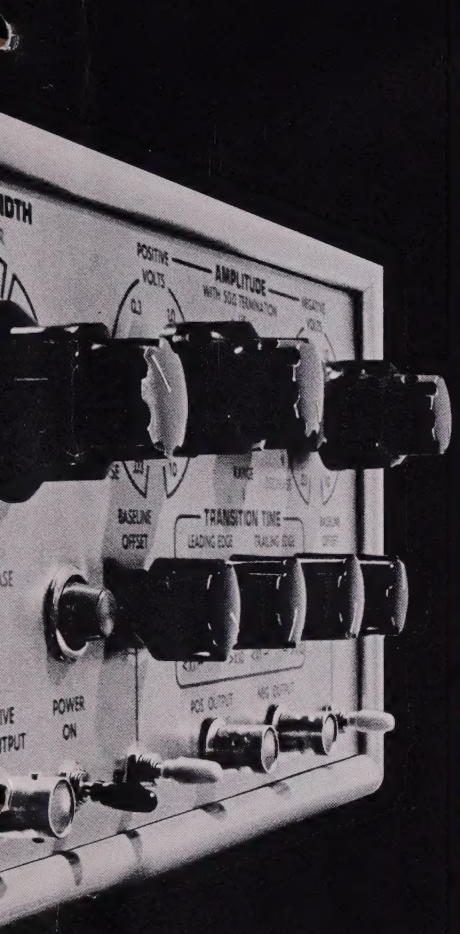
EFFECTIVE ON: Serial No. 087 and subsequent

REFERENCE: Datapulse Schematic Dwg. J40000 101, Zone 3, Model 109 and 110 Front End.

1. Change R 52 and R 60 to 51 Ohm, 1/4 w, 5%. Datapulse Part No. 10010-510, Allen-Bradley Part No. C85605

2. Change DL-50 to 85 nanosec., 50 ohm. Datapulse Part No. 14225-085, Bechman Part No. 8091-70-0

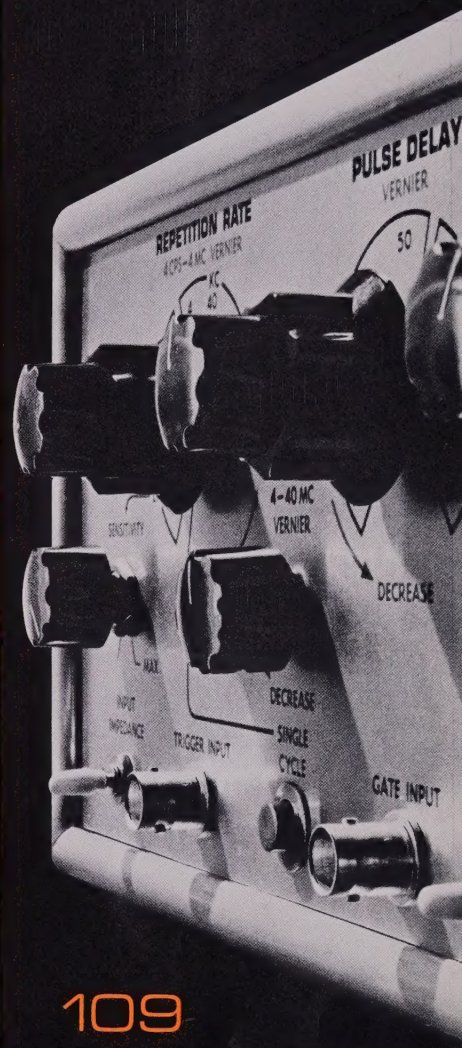
40mc GENERAL PURPOSE PULSE GENERATORS



110

The 110 Pulse Generator offers maximum flexibility, with 6 nanosec to 500 μsec linear rise and fall time control and up to 10v independent DC offset on each output.

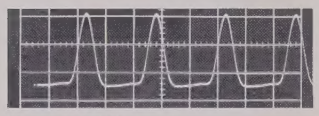
4 cps to 40 mc rep. rates
Pos. and neg. 10v into 50 ohms
Rise times from 5 nanosec



109

The 109 Pulse Generator offers all basic capabilities of the 110, but at significant cost savings. Rise time is fixed at 5 nanosec and output baselines are at ground.

Features - Models 110 and 109

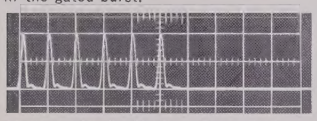


40 mc repetition rate

VERY LOW TO ULTRA-HIGH REP. RATE — high rep. rate and narrow pulse width capabilities cover most requirements for high speed digital circuitry. Low rep. rate and wide pulse capability permit use as a square wave generator.

FLEXIBLE EXTERNAL TRIGGERING — convenient, built-in 50 ohm termination permits reliable triggering at high frequencies and eliminates need for external cable terminations. At lower frequencies, 500 ohm input impedance can be selected to provide less trigger loading.

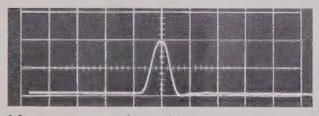
GATED OPERATION — pulse train may be interrupted during the duration of an externally provided gating signal. The gating signal does not interrupt the sync output and does not alter pulse characteristics. Negligible difference in waveform is noted between first and last pulse in the gated burst.



10 mc output with 6 cycles gated

WIDE RANGE DELAY — useful in gating, phasing, and radar design applications. Decade ranges (10 to 50 nanosec. on lowest range) provide smooth control and high resolution at all settings.

NARROW PULSE OUTPUT TO 10 NANOSEC. — provides impulse type signals for high speed circuit development, high frequency complex impedance analysis, and other transient tests.

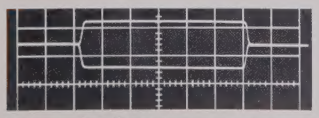


10 nanosec pulse width

HIGH DUTY CYCLE — width, amplitude, delay, and waveform remain stable at very high duty cycles. Output stages cannot be damaged by any combination of panel control settings, short circuits of any duration, or back voltages of up to ±10v.

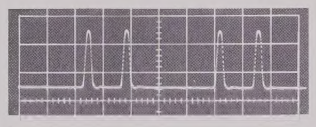
WIDE PULSES — pulse widths to 5 millisec. (50 millisec. for Model 109) permit square wave generation down to 100 cps (10 cps for Model 109).

SEPARATELY VARIABLE SIMULTANEOUS POS. AND NEG. OUTPUTS — available to 10v into 50 ohms in either single or double pulse modes. Clean waveforms are available at amplitudes as low as 10 mv for low level signal simulation and noise susceptibility testing.



800 mv simultaneous pos. and neg. outputs

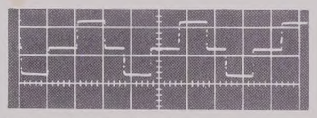
DOUBLE PULSE OPERATION — for flip-flop resolution checks, navigational signal simulation, etc. Provides two identical pulses in each cycle, with separation between pulses governed by the delay control.



Double pulse output at 4 mc repetition rate

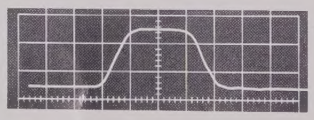
SINGLE CYCLE — single output pulses or pulse pairs, fully controllable in all parameters, may be reliably generated by pushbutton operation. This feature is particularly useful in trouble-shooting logic and counting circuitry.

MIXED OUTPUT PULSES — with DC coupled outputs and ability to withstand back voltages, the outputs of multiple units may be connected together to provide fully controllable pulse pairs, complex, and bipolar waveforms for special test requirements.



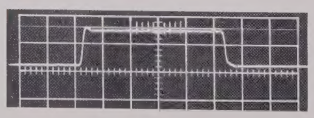
Pos. and neg. mixed output pulses

FAST RISE TIMES AND CLEAN WAVEFORM — permit reliable analysis of storage and recovery time characteristics of high speed components. Coupled with duty cycle capabilities and wide-range timing controls, the fast rise times permit high frequency square wave testing, reflection testing of transmission lines, and other transient analysis.



Fast rise & fall time (5ns/cm)

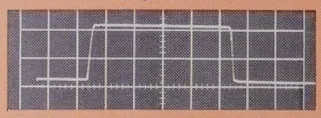
50 OHM SOURCE IMPEDANCE — Current source at max. amplitude reduces to approx. 50 ohm constant source impedance at amplitudes less than 5v.



3v output through unterminated 50 ohm cable

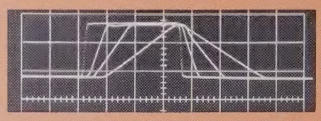
Features Model 110 only

WIDE RANGE CONTROL OF PULSE AMPLITUDE — amplitude is separately controlled for positive and negative outputs, continuously variable from 10 mv to 10v into 50 ohms. Minimum pulse distortion is assured at low amplitudes by use of constant impedance type attenuators for amplitude control.



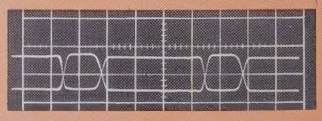
200mv pulse

INDEPENDENTLY VARIABLE, LINEAR RISE AND FALL TIMES FROM 6 NANOSEC — permits marginal testing and exact simulation of pulse circuit rise and fall times. Assures repeatability of test results. Wide-range control allows generation of ramps and triangular waveforms for sweep and ranging waveform simulation, amplifier linearity tests, etc.



Separately variable rise and fall time control

SIMULTANEOUS COMPLEMENTARY OUTPUTS — use of variable DC offset provides simultaneous complementary output pulses (Q and $\overline{Q}$) at any level between ±10v for simulation of logic signals and logic circuit tolerancing.

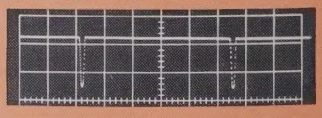


Simultaneous complementary outputs

VARIABLE BASELINE LEVEL — provides DC biased outputs for off-ground logic simulation, also ideal for worst case tolerancing of logic circuitry and noise susceptibility analysis.

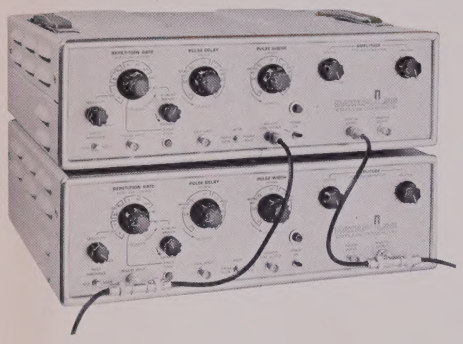
Controllable baseline levels

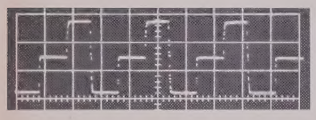
ULTRA-HIGH DUTY CYCLES — low duty cycle signals with baseline offset equal to amplitude effectively become an opposite polarity signal at high duty cycle. This feature allows generation of either polarity output at duty cycles approaching 100%.



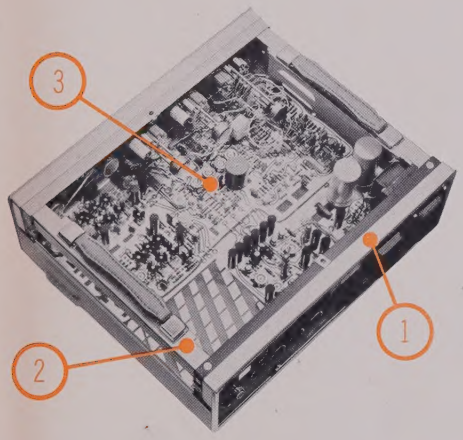
Ultra-high duty cycle pos. output (Neg. pulse with pos. baseline offset)

109
Pulse Generator





Two model 109's mixed to provide bipolar output.



1. Rigid mechanical structure minimizes shock and vibration effects.
2. Quick-release top and bottom covers quickly expose all circuitry for test and adjustment.
3. Functional layout of single printed circuit board facilitates service.

Model 109 Specifications

MODES OF OPERATION — Single Pulse or Double Pulse, selected by panel toggle switch. In the Double Pulse Mode, two main pulses are provided at the output during each cycle (essentially identical in width, amplitude, polarity, rise time, and fall time), one approx. 10 nanosec before the Sync Output and the second at a position determined by the pulse delay controls.

REPETITION RATE — Continuously variable from 4 cps to 40 mc, covered in six decade ranges. Maximum rate on Double Pulse Mode is 20 mc.

EXTERNAL TRIGGER — Operates at 0-40 mc (20 mc maximum on Double Pulse Mode) from ±1.5v pulses with rise time less than 20 nanosec and duration greater than 20 nanosec (requires greater amplitude for slower rise times or lesser duration). Sensitivity control is provided to allow adjustment for noise rejection. Input impedance may be selected by panel switch as 50 ohms or 500 ohms. Maximum dc level or transient amplitude which may be applied is ±25v with sensitivity control at maximum.

SINGLE CYCLE — Operation of a front panel pushbutton provides one cycle (single or double pulse, as selected) of output.

GATED OPERATION — External gate signal levels of +3.5v or more block main pulse outputs but do not interrupt the Sync Output; no connection or levels of zero or less enable outputs. Input resistance is approx. 1000 ohms. Levels greater than ±25v may not be applied.

SYNC OUTPUT — Negative 4v from 50 ohms (2v into 50 ohms), approx. 20 nanosec duration, approx. 5 nanosec rise and fall time with 50 ohm load. Sync occurs approx. 65 nanosec after external trigger if used.

MAIN PULSE DELAY, SINGLE PULSE MODE (of leading edge from sync output) — Continuously variable from approx. 10 nanosec advance to 50 millisec delay, covered in six decade ranges plus 10 to 50 nanosec range. Maximum delay duty cycle is typically 85%, decreasing to at least 50% at 30mc and 40% at 40mc repetition rate.

FIRST PULSE POSITION, DOUBLE PULSE MODE — Leading edge occurs approx. 10 nanosec before Sync Output.

PULSE SEPARATION, DOUBLE PULSE MODE — Leading edge of first pulse to leading edge of second pulse is continuously variable by means of Pulse Delay controls from 25 nanosec to 50 millisec. Minimum trailing edge to leading edge separation is approx. 30% of pulse width or 15 nanosec, whichever is greater.

PULSE DURATION — Continuously variable from 10 nanosec to 50 millisec, covered in six decade ranges plus 10 to 50 nanosec range. Maximum duty cycle is typically 85%, decreasing to at least 50% at 30mc and 40% at 40mc.

JITTER — Repetition rate jitter is less than 0.05%. Delay and width jitter is less than 0.1%.

MAIN PULSE OUTPUT — Positive and negative outputs are provided simultaneously. Outputs are dc coupled with baseline at ground.

PEAK AMPLITUDE (Separately Controlled for Positive and Negative Outputs) — Continuously variable from less than 1v to 10v into 50 ohms.

RISE AND FALL TIMES (With 50 ohm Resistive Load) — Less than 5 nanosec. Type 2401 Rise Time Integrator accessory available allows variable rise time control (exponential waveform) from 5 to 60 nanosec, also controlling fall time but with lesser effect, with approx. 2 db (20%) insertion loss.

WAVEFORM ABERRATIONS (With Properly Connected 50 Ohm Load) — Overshoot, undershoot, ring, and top slope are less than 5% at amplitudes of 3v and higher.

OUTPUT PROTECTION — Output stages will not be damaged by any combination of panel control settings, short circuits of any duration, or back voltages up to ±10v.

OUTPUT MIXING — Positive and/or negative outputs of multiple units may be directly mixed with each other or with other outputs (±10v max.). Mixed outputs add approx. algebraically to a maximum of 10v.

OPERATING TEMPERATURES — The unit is rated for operation at ambient temperature of 0° to 50°C.

POWER REQUIRED — 105v to 125v, 50/60 cycle ac, approx. 50 watts. 220v operation may be specified at no added cost.

PHYSICAL — Aluminum panel with etched red and black markings, beige cabinet with quick-release top and bottom covers. BNC signal connectors. 5½"H x 17"W x 15¼"D; approx. 30 lbs. May be rack mounted (5¼"H x 19"W panel space) by specifying Model 109R, or by installing Type 1003 Rack Mounting Set.

ACCESSORIES FURNISHED — One operation and maintenance manual, 8 ft line cord with NEMA 3-prong plug.

ACCESSORIES AVAILABLE — Type 2401 Rise Time Integrator (adds variable rise and fall control); Type 2201 Mixer (for best waveform when mixing same polarity outputs of two units); Type 2003 Termination, 50 ohm, 25 w; Type 1003 Rack Mounting Set, and extra instruction manuals.

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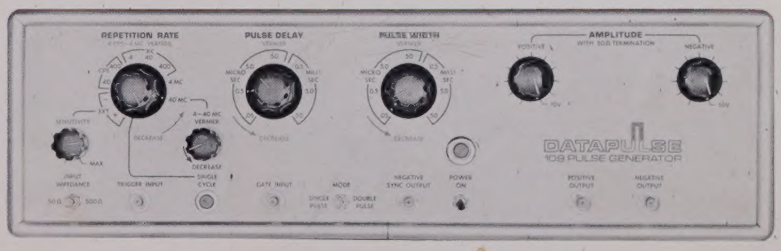
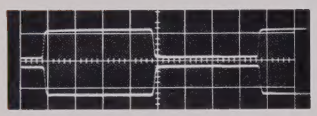
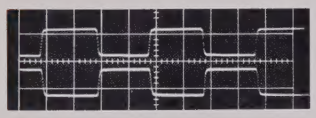
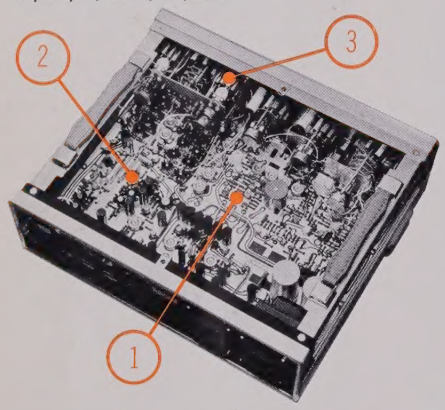


110
Pulse Generator





Outputs of two model 110's connected to simulate two binary counter connected flip-flop Q and $\bar{Q}$ outputs.



1. Major components are labelled and test points provided for troubleshooting.
2. Output transistor heat sinks increase component derating.
3. Shielded attenuator sections minimize feed-through at low output levels.

Model 110 Specifications

MODES OF OPERATION — Single Pulse or Double Pulse, selected by panel toggle switch. In the Double Pulse Mode, two main pulses are provided at the output during each cycle (essentially identical in width, amplitude, polarity, rise time, and fall time). One Output appears approx. 25 nanosec before the Sync Output and the second at a position determined by the pulse delay controls.

REPETITION RATE — Continuously variable from 4cps to 40mc, covered in six decade ranges. Maximum rate on Double Pulse Mode is 20mc.

EXTERNAL TRIGGER — Operates at 0-40mc (20mc maximum on Double Pulse Mode) from ±1.5v pulses with rise time less than 20 nanosec and duration greater than 20 nanosec (requires a greater amplitude for slower rise times or lesser duration). Sensitivity control is provided to allow adjustment for noise rejection. Input impedance may be selected by panel switch as 50 ohms or 500 ohms. Maximum dc level or transient amplitude which may be applied is ±25v with sensitivity control at maximum.

SINGLE CYCLE — Operation of a front panel pushbutton provides one cycle (single or double pulse, as selected) of output.

SYNC OUTPUT — Negative 4v from 50 ohms (2v into 50 ohms), approx. 20 nanosec duration, approx. 5 nanosec rise and fall time with 50 ohm load. Sync occurs approx. 100 nanosec after external trigger if used.

GATED OPERATION — External gate signal levels of +3.5v or more, block main pulse outputs but do not interrupt the Sync Output; no connection or levels of zero or less enable outputs. Input resistance is approx. 1000 ohms. Levels greater than ±25v may not be applied.

MAIN PULSE DELAY, SINGLE PULSE MODE (of minimum rise time leading edge from Sync Output) — Continuously variable from approx. 10 nanosec advance to 50 millisec delay, covered in six decade ranges plus 10 to 50 nanosec range. Maximum delay duty cycle is typically 85%, decreasing to at least 50% at 30mc and 40% at 40mc repetition rate.

FIRST PULSE POSITION, DOUBLE PULSE MODE — Minimum rise time leading edge occurs approx. 25 nanosec before Sync Output.

PULSE SEPARATION, DOUBLE PULSE MODE — Leading edge of first pulse to leading edge of second pulse is continuously variable by means of Pulse Delay controls from 25 nanosec to 50 millisec. Minimum trailing edge to leading edge separation (at min. rise and fall times) is approx. 30% of pulse width or 15 nanosec, whichever is greater.

PULSE DURATION — Continuously variable from 10 nanosec to 5 millisec, covered in five decades plus 10 to 50 nanosec range. Maximum duty cycle is typically 85%, decreasing to at least 50% at 30mc and 40% at 40mc.

JITTER — Repetition rate jitter is less than 0.05%. Delay and width jitter is less than 0.1%.

MAIN PULSE OUTPUT — Positive and negative outputs are provided simultaneously. Outputs are dc coupled.

PEAK AMPLITUDES (separately controlled for Positive and Negative Outputs) — Continuously variable from less than 10mv to 10v into 50 ohms.

RISE AND FALL TIMES, 10 TO 90% POINTS (simultaneous control of Positive and Negative Outputs) — With outputs terminated into 50 ohms, continuously variable from less than 6 nanosec to at least 0.5 millisec, covered in five decade related ranges by a common control plus separate fill-in controls for rise and fall times. Transition times slower than 20 nanosec are linear within ±5%. Maximum ratio of leading to trailing edge transition times, or vice versa, is typically 15:1. Ratios up to 100:1 are available on special order.

PULSE BASELINE OFFSET — By means of front panel controls, the baseline offset may be independently adjusted from +2v to −10v on the positive output, and from −2v to +10v on the negative output. Baselines may be set at ground (Zero Volts) by panel toggle switches.

WAVEFORM ABERRATIONS (with properly connected 50 ohms load) — Overshoot, undershoot, ring, and top slope are less than 3% at amplitudes of 300mv and higher.

OUTPUT PROTECTION (with baseline at ground) — Output stages will not be damaged by any combination of panel control settings, short circuits of any duration, or back voltages up to 10v.

OUTPUT MIXING — Positive and/or negative outputs of multiple units may be directly mixed with each other or with other outputs (±10v max.) provided baseline offset is at zero volts. Mixed outputs add approx. algebraically to a maximum of 10v.

OPERATING TEMPERATURES — The unit is rated for operation with ambient temperature from 0° to 50°C.

POWER REQUIRED — 105v to 125v, 50-400 cycle ac, approx. 50 watts. 220v operation may be specified at no added cost.

PHYSICAL — Aluminum panel with etched red and black markings, beige cabinet with quick-release top and bottom covers, BNC signal connectors. 5½"H x 17"W x 15¼"D; approx. 30 lbs. May be rack mounted (5¼"H x 19"W panel space) by specifying Model 110R, or by installing Type 1003 Rack Mounting Set.

ACCESSORIES FURNISHED — One operation and maintenance manual, 8 ft. line cord with NEMA 3-prong plug.

ACCESSORIES AVAILABLE — Type 2201 Mixer (for best waveform when mixing same polarity outputs of two units); Type 2003 Termination, 50 ohm, 25 w; Type 1003 Rack Mounting Set, and extra instruction manuals.

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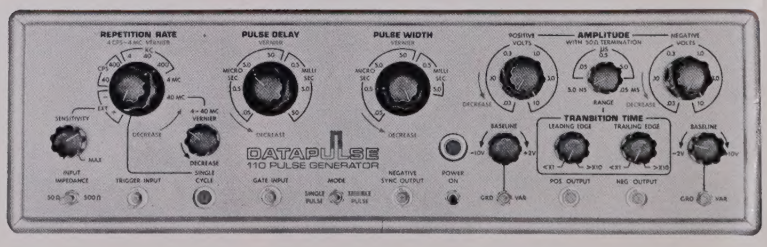


Model 110

1.0 EQUIPMENT REQUIRED

a. Triplett 630 VOM, or equivalent.

b. Tektronix Model 561 Sampling Scope or equivalent.

c. Tektronix Model 543 Scope with CA Plug-in or equivalent.

d. Datapulse M109 Pulse Generator.

e. Hewlett-Packard Model 202C Oscillator or equivalent.

f. Variable voltage transformer, 0-140v, 60 cps, 6 amp.

g. Resistor, WW, 100Ω, 10w.

2.0 POWER SUPPLY SECTION

a. Disconnect all voltage jumpers from power supply to front end and output amplifier sections.

b. Disconnect one end of R511 and R532.

c. Adjust variac for 115 vac and plug in M109.

d. Adjust R517 for +25v, ±3%.

e. Adjust R520 for +5, 5v, ±5%.

f. Load +25v to ground with 100Ω. +25v should not change more than ±0. 5v.

g. Adjust variac so that ac input to M109 varies from 105v to 125v. +25v should not change more than ±0. 5v.

h. Load +5. 5v to ground with 100Ω. +5. 5v should not change more than ±0. 5v.

i. Adjust R538 for -25v, ±3%.

j. Adjust R541 for -5. 5v, ±5%.

k. Load -25v to ground with 100Ω. -25v should not change more than ±0. 5v.

l. Adjust variac so that ac input to M109 varies from 105v to 125v. -25v should not change more than ±0. 5v.

m. Load -5. 5v to ground with 100Ω. -5. 5v should not change more than ±0. 5v.

n. Make certain all loads are disconnected from power supply.

3.0 FRONT END SECTION

Connect voltage jumpers from power supply to front end section.

3.1 Clock Generator Adjustment

a. Monitor TP2 with Tektronix 543 scope.

b. Set M109 Repetition Rate Control to 4 Mc position.

c. Waveform at TP2 should be negative pulse from +5.5v to +2v with rise and fall times faster than 20 nanosec.

d. Turn Repetition Rate Vernier Control, R4, to maximum clockwise position.

e. Adjust R3 for frequency of 4.4 Mc.

f. Turn Repetition Rate Vernier Control, R4, to maximum counter-clockwise position.

g. Adjust R2 for frequency of 360 kc.

h. Repeat Steps a through g.

i. Check the upper and lower lomits of each repetition rate range. Make certain that the ranges overlap each other. If the ranges do not overlap, readjust R3 and R2 the amount required for overlapping. If R2 and R3 have to be changed significantly, check timing capacitor tolerances.

j. Monitor TP2 with Tektronix 561 scope using P6035 passive probe (5k input Z).

k. Set Repetition Rate Control to 40 Mc position. Turn 40 Mc Repetition Rate Vernier, C5, to maximum clockwise position.

l. Adjust C4 for frequency of 40 Mc.

m. Turn 40 Mc Vernier Control to maximum counter-clockwise position. Frequency should be less than 4.3 Mc. If frequency is greater than 4.3 Mc, R5 should be increased until the frequency is less than 4.3 Mc. If R5 is changed, C4 must be readjusted.

n. Turn Repetition Rate Control to -EXT position. Turn EXT Sensitivity Control (R32) to maximum clockwise position. Set Input Impedance Z Switch (S31) to the 50Ω position.

o. Adjust the Negative Output Control of tested M109 for 1.5v. Couple the output to Trigger Input of M109 under test with 50Ω coaxial cable. Vary the frequency of tested M109 from 4 Mc to 40 Mc. The M109 under test should trigger reliably through the entire range.

p. Repeat Step o only, using a positive pulse with the Repetition Rate Control set to +EXT position. Ascertain that the unit will trigger reliably from 4 Mc to 40 Mc with 1.5v positive pulse.

q. Turn Input Z Control (S31) to 500Ω position. Set output of H.P. 202C Oscillator for 1.5v rms and check M109 for reliable triggering from 4 cps to 1 kc in both the -EXT and +EXT positions of Repetition Rate Control.

r. Turn Repetition Rate Control to Single Cycle position. Verify that one and only one pulse is generated at TP2 for every depression of the Single Cycle Pushbutton.

3.2 Sync Output Amplifier Checkout

a. Feed sync output of M109 to 50Ω input of Tektronix 561 (set trigger mode of 561 to -Int. Pos.).

b. Vary frequency of M109 from 4 Mc to 40 Mc.

c. The waveshape should be a negative going pulse of at least 2v amplitude with rise and fall times less than 6 nanosec. The amplitude of the pulse should not vary more than 10% from 4Mc to 40 Mc. The width of the pulse should be approximately 25 nanosec and will vary with frequency. Observe the baseline and ascertain that no spurious signals (greater than ±0.1v) appear as the frequency is varied from 4 Mc to 40 Mc.

3.3 Gating Circuit Checkout

a. Monitor TP4 with Tektronix 543.

b. Set frequency of M109 for 4 Mc.

c. Waveform at TP4 should be a negative going signal from 0v to -5v of approximately 15 nanosec in width. The rise and fall of the signal should be less than 10 nanosec.

d. Feed positive output of tested M109 to the Gate Input of M109 under test. Adjust frequency and width of tested M109 for 1 kc square wave. Trigger scope with sync output of tested M109.

e. Adjust Amplitude Control of tested M109 for +3.5v. The waveform at TP4 should be a burst train of pulses with a burst rate of 1 kc and a pulse rate of 4 Mc.

f. Decrease amplitude of tested M109 to +1.5v. The waveform at TP4 should now be a continuous pulse train of 4 Mc.

3.4 Delay One-Shot Checkout

a. Monitor emitter of Q20 with P6035 probe of Tektronix 561.

b. Adjust frequency of M109 for 100 kc. Set Delay Control to 0.5 μs position. Turn Delay Vernier to maximum counterclockwise position.

c. Adjust R91 so that positive (4v) pulse at emitter of Q20 is 0.45 μs wide (50% amplitude points).

d. Set Delay Vernier of M109 to maximum clockwise position.

e. Adjust R88 so that pulse width at emitter of Q20 is 5.5 μs.

f. Repeat Steps c through e.

g. Set Delay Control of M109 to 0.05 μs position. Turn Delay Vernier to maximum clockwise position.

h. Adjust C85 for pulse width of 50 nanosec at emitter of Q20.

i. Put P6035 probe of Tektronix 561 on TP5. There should be a positive pulse, from +2v to +5v, of 10 nanosec width with rise and fall times of approximately 10 nanosec.

j. Vary Delay Vernier from maximum counterclockwise position to maximum clockwise position. Observe pulse amplitude as delay is varied and make certain that it does not vary by more than 10%. In addition, the pulse should move smoothly as a function of delay vernier and no "skipping" should occur.

k. Monitor emitter of Q20 with Tektronix 543 scope. Check the limits of each delay range. Make certain that the ranges overlap each other. If there are "holes" in the delay ranges, adjust either R88 or R91, or both to eliminate "holes." In the event that R88 or R91 have to be changed significantly (greater than 10%) from their original setting, check the tolerances of the timing capacitors.

3.5 Mixing Circuit Checkout

a. Adjust M109 for frequency of 4 Mc. Set Delay Controls for minimum delay (both controls maximum counterclockwise). Flip Pulse Mode Switch to Single Pulse position.

b. Monitor TP6 with Tektronix 561 and P6035 probe.

c. Adjust C114 for 10 nanosec wide negative pulse of 3v amplitude.

d. Flip Pulse Mode Switch to Double Pulse position. There should be two pulses appearing at TP6. Adjust the Delay Vernier Control so that the two pulses are separated by 25 nanosec (leading edge to leading edge).

e. Adjust C111 so that the first and second pulses are of approximately equal amplitude. C111 and C114 interact slightly with each other; therefore, both must be adjusted.

f. Turn Delay Vernier of M109 in clockwise direction and note amplitude of both pulses as delay is advanced. The amplitudes should not change by more than 10%. If amplitudes do change more than 10%, readjust C111 and C114.

3.6 Width One-Shot Checkout

a. Adjust M109 for 100 kc frequency and minimum delay. Set Pulse Width Control to 0.5 μs position. Monitor TP7 with Tektronix 561 and P6035 probe.

b. Turn Width Vernier Control to maximum counterclockwise position. Adjust R132 for positive 3v pulse of 0.45 μs (50% amplitude points) at TP7.

c. Turn Width Vernier Control to maximum clockwise position. Adjust R129 for 5.5 μs pulse width at TP7.

d. Repeat Steps b and c.

e. Set Width Control to 0.05 μs position. Turn Width Vernier Control to maximum clockwise position. Adjust C126 for pulse width of 50 nanosec at TP7.

f. Vary Width Vernier Control from maximum counterclockwise position to maximum clockwise position. Observe amplitude of pulse as width is varied and make certain that it does not vary by more than 10%. In addition, the pulse width should increase smoothly without hesitation or skipping.

g. Observe TP8 with Tektronix 561 and P6035 probe. Turn Width Controls of M109 to minimum width position. Adjust C134 for negative pulse of approximately 4v amplitude and 10 nanosec width.

h. Monitor TP7 with Tektronix 543. Check the limits of each width range. Make certain that the ranges overlap each other. If "holes" exist in the width ranges, adjust either R129 or R132, or both. The amount of readjustment required should be slight; if this is not true, check tolerances of timing capacitors.

4.0 OUTPUT AMPLIFIER SECTION

Connect voltage jumpers from power supply to output amplifier. Trigger oscilloscope with sync output of M109.

4.1 Positive Output Amplifier Checkout

a. Connect Positive Output of M109 to Tektronix 561 50Ω input through 10:1 (20 db) attenuator.

b. Set frequency of M109 for 400 kc, width for 50 nanosec, and delay for 50 nanosec. Turn Positive Amplitude Control to maximum clockwise position.

c. Adjust R318 for best appearing pulse with amplitude between 10v and 12v.

d. Adjust Cp for minimum pulse aberration.

e. Check rise and fall times for less than 5 nanosec.

f. Adjust M109 for minimum pulse width. Vary frequency from 4 Mc to 40 Mc. Note frequency at which maximum width occurs. Set M109 to this frequency and adjust C134 for pulse width of 10 nanosec.

g. Vary Amplitude Control. Amplitude of pulse should decrease to less than 3v before distortion occurs.

4.2 Negative Output Amplifier

a. Connect Negative Output of M109 to Tektronix 561 50Ω input through 20 db of attenuation.

b. Set frequency for 400 kc, width for 50 nanosec, and delay for 50 nanosec. Turn Negative Amplitude Control to maximum clockwise position.

c. Adjust R339 for best appearing pulse with amplitude between 10v and 12v.

d. Adjust Cn for minimum pulse aberration.

e. Check rise and fall times for less than 10 nanosec.

f. Adjust M109 for minimum pulse width. Vary frequency from 4 Mc to 40 Mc. Note frequency at which maximum width occurs. Set M109 to this frequency and adjust C331 for 10 nanosec pulse width.

g. Vary Amplitude Control. Amplitude of pulse should decrease to less than 3v before distortion occurs.

5.0 FINAL CHECKOUT

a. Set M109 for 4 Mc frequency, minimum pulse delay, and minimum pulse width. Turn both Amplitude Controls to half setting.

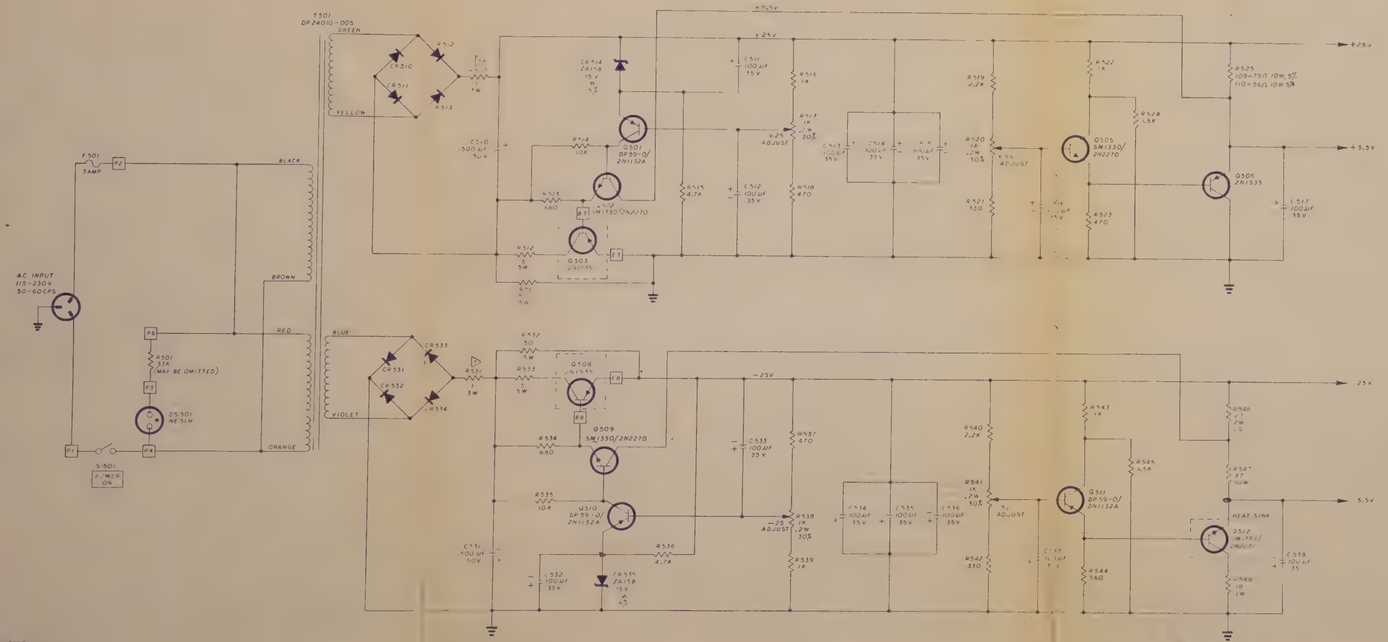
b. Trigger 561 scope with sync output of M109. Observe positive output of M109 with P6035 probe directly at BNC connector. Note carefully the position at which the pulse occurs on the face of the scope. Now put probe on back of sync output BNC connector. Note position at which the sync pulse appears on face of scope. This position should lag the previous position by 10 nanosec.

c. Set frequency of M109 for 4 Mc. Put Pulse Mode Switch to Double Pulse position. Adjust delay between first and second pulse for 25 nanosec (viewing positive output of M109 with 50Ω input of 561). Increase frequency until a continuous pulse train with 25 nanosec spacing is obtained (40 Mc effective repetition rate). The amplitude difference between adjacent pulses should be less than ±5%.

d. Monitor both positive and negative outputs of M109 on alternate channels (50Ω input) of 561. Adjust M109 for minimum delay and width at frequency of 40 Mc. Increase pulse width until erratic operation occurs. The pulse width at which erratic operation starts should be greater than 13 nanosec. This corresponds to a duty cycle of 50%.

e. Load both positive and negative outputs of M109 into 50Ω. Adjust M109 for maximum pulse width and delay at frequency of 4 cps. Monitor both M109 outputs on alternate channels of Tektronix 543 and observe flat top droop on both pulses. They should exhibit less than 5% droop. Vary line voltage from 105v ac to 125v ac. There should be no significant changes (less than 3%) in any pulse characteristic as line voltage is varied.

This completes initial checkout. Unit should be aged for 24 hours and recalibrated.



▷ - NOT USED IN MODEL 110

6 - Q503-Q508 ARE MOUNTED ON BACK PANEL
3 - CONNECT BROWN AND RED WIRES
2 - BREAK CONNECTION BETWEEN BROWN AND ORANGE WIRES
1 - BREAK CONNECTION BETWEEN BLACK AND RED WIRES
FOR 230 VAC OPERATION

5 - T501 IS SHOWN CONNECTED FOR 115 VAC OPERATION

4 - [BOXED] LETTERS AND/OR NUMBERS INDICATE SPECIFIC POINTS ON CIRCUIT BOARD

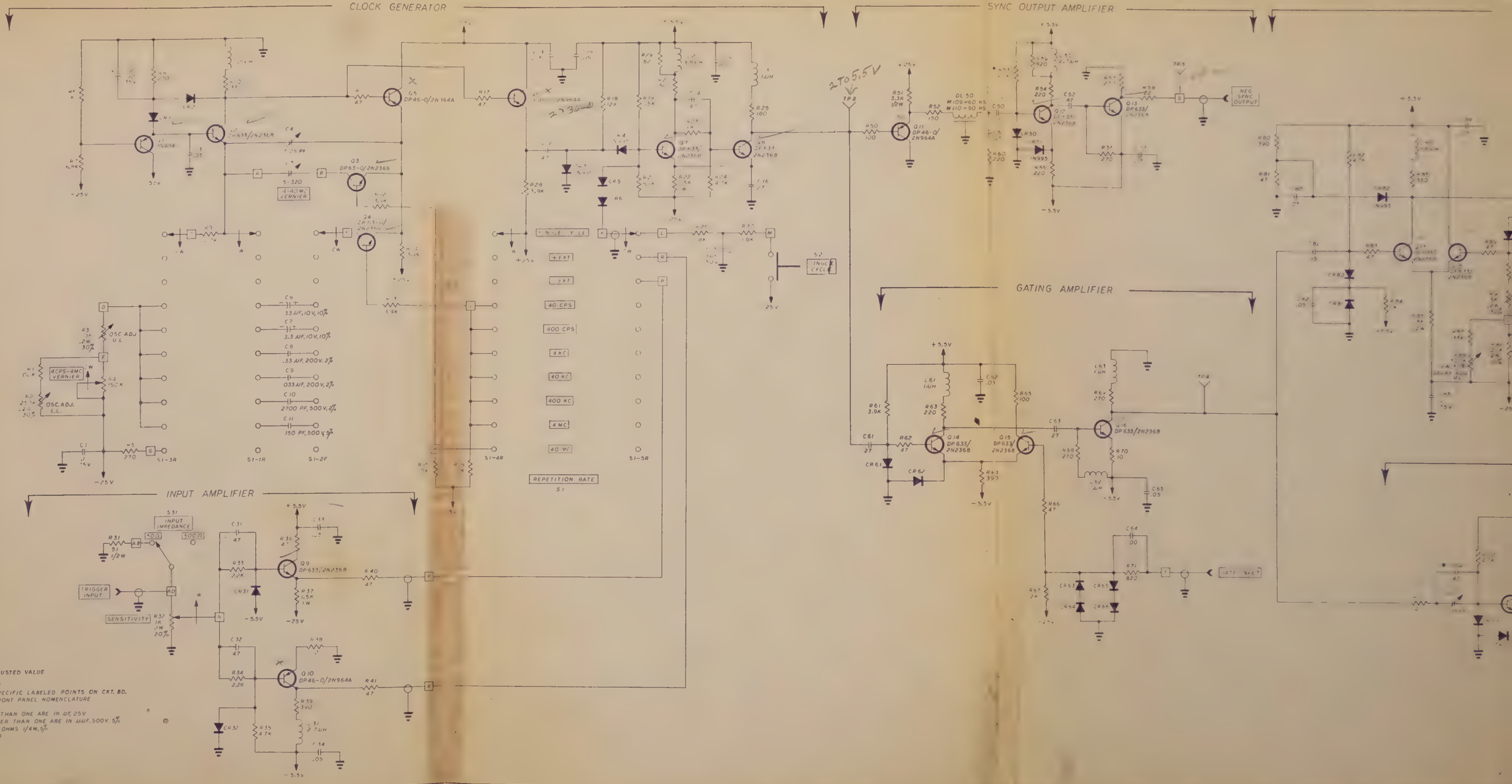
3 - [BOXED] WORDING INDICATES FRONT PANEL NOMENCLATURE

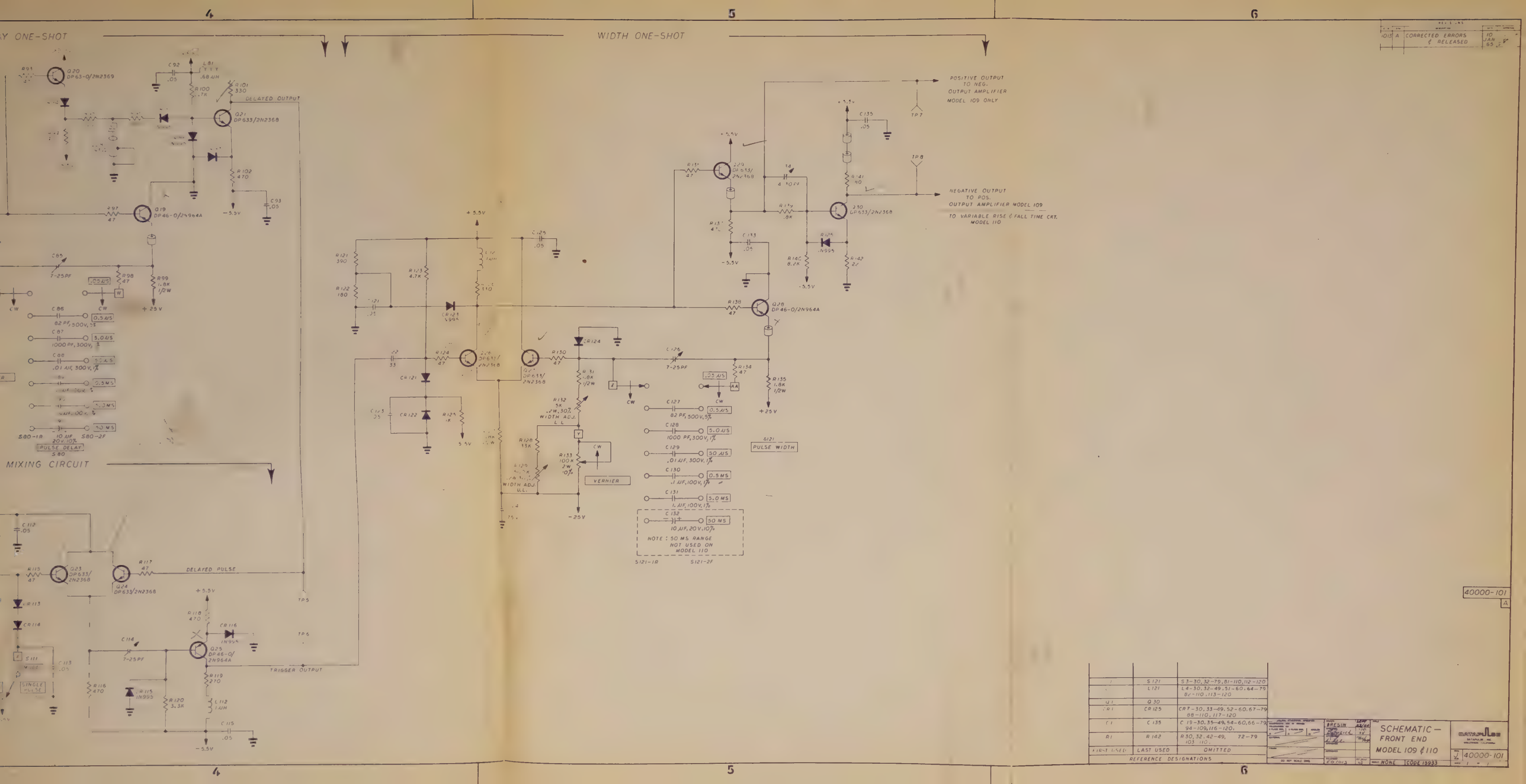
2 - ALL DIODES ARE DP59-1/2 N4002

1 - ALL RESISTORS ARE ¼ OHMS ±10% 5%

NOTES: UNLESS OTHERWISE SPECIFIED

SCHEMATIC -
POWER SUPPLY
MODEL 109 & 110
NONE 40004-13233
40000/100


CLOCK GENERATOR
SYNC OUTPUT AMPLIFIER
GATING AMPLIFIER
INPUT AMPLIFIER
OSC ADJ U.L.
4CPS-4MC VERNIER
OSC ADJ. L.L.
5-320 1-40 MC VERNIER
INPUT IMPEDANCE
TRIGGER INPUT
SENSITIVITY
SINGLE CYCLE
REPETITION RATE
S1
+EXT
EXT
40 CPS
400 CPS
4 KC
40 KC
400 KC
4 MC
40 MC
NEG SYNC OUTPUT
POS SYNC OUTPUT
2 TO 5.5V
+5.5V
-5.5V
-25V
TP2
TP3
TP4
* INDICATES A FACTORY ADJUSTED VALUE
INDICATES A FERRITE BEAD
LETTERS INDICATES SPECIFIC LABELED POINTS ON CKT. BD.
WORDING INDICATES FRONT PANEL NOMENCLATURE
ALL DIODES ARE DP16-0
ALL CAPACITOR VALUES LESS THAN ONE ARE IN UF, 25V
ALL CAPACITOR VALUES GREATER THAN ONE ARE IN MMF, 500V, 5%
ALL RESISTOR VALUES ARE IN OHMS 1/4W, 5%
UNLESS OTHERWISE SPECIFIED



REV		
1013	A	CORRECTED ERRORS & RELEASED

	S121	S3-30,32-79,81-110,112-120
	L121	L4-30,32-49,51-60,64-79 B2-110,113-120
U1	Q30	
CR1	CR125	CR7-30,33-49,52-60,67-79 88-110,117-120
C1	C135	C19-30,35-49,54-60,66-79 94-109,116-120.
R1	R142	R30,32,42-49, 72-79 103-110.
FIRST USED	LAST USED	OMITTED
REFERENCE DESIGNATIONS		

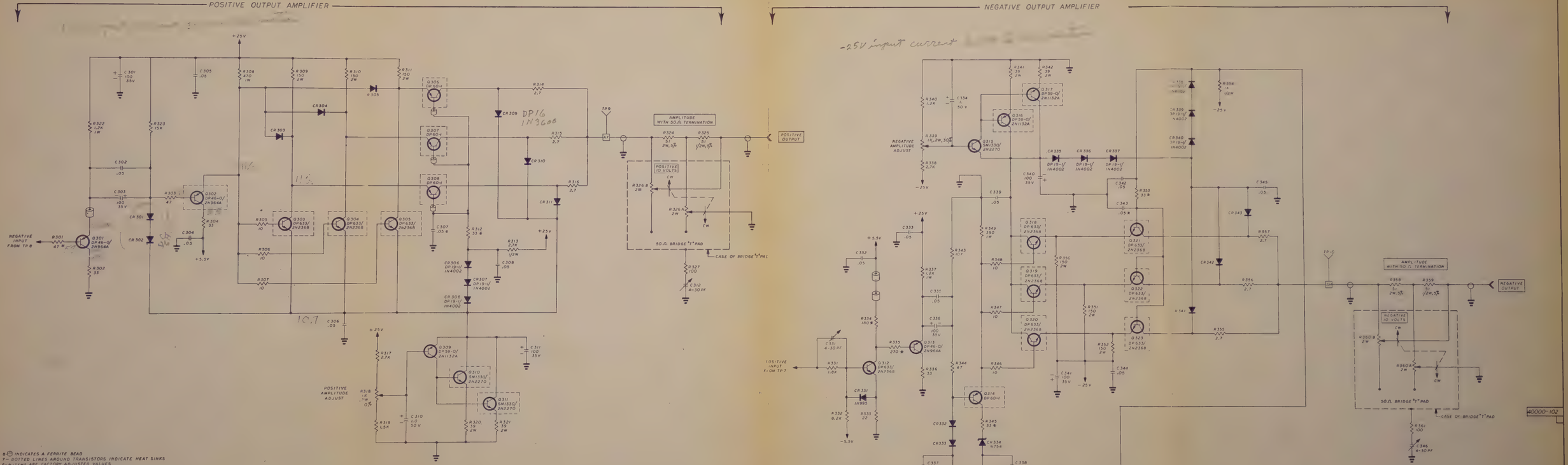
DRAWN	BRESIN	12/29/64
CHECKED		1/7
ENGINEER		1/7
APPROVED		1/7
MFG		1/7
QUALITY	ZOTOS	1/7

SCHEMATIC — FRONT END MODEL 109 & 110

DATA LAB

SIZE NONE | CODE 13933 | 40000-101 | REV A | SHEET 1 OF 1

40000-101 A


POSITIVE OUTPUT AMPLIFIER
NEGATIVE OUTPUT AMPLIFIER
-25V input current
+25V
+5.5V
-5.5V
-25V
NEGATIVE INPUT FROM TP8
POSITIVE INPUT FROM TP7
POSITIVE AMPLITUDE ADJUST
NEGATIVE AMPLITUDE ADJUST
AMPLITUDE WITH 50Ω TERMINATION
POSITIVE OUTPUT
NEGATIVE OUTPUT
POSITIVE 10 VOLTS
NEGATIVE 10 VOLTS
50Ω BRIDGE "T" PAD
CASE OF BRIDGE "T" PAD
TP8
TP7
TP10
DP16 IN3606
10.7
11.5
1 INDICATES A FERRITE BEAD
7 — DOTTED LINES AROUND TRANSISTORS INDICATE HEAT SINKS
6 — ITEMS ARE FACTORY ADJUSTED VALUES
5 — BOXED LETTERS INDICATE SPECIFIC LABELED POINTS ON CKT. BD.
4 — BOXED WORDING INDICATES FRONT PANEL NOMENCLATURE
3 — ALL DIODES ARE DP16-0/ IN3600
2 — ALL CAPACITOR VALUES LESS THAN ONE ARE IN μF, 75V
1 — ALL RESISTOR VALUES ARE IN OHMS, 1/4W, 5%
NOTES: UNLESS OTHERWISE SPECIFIED
C 301 C 323
C 301 C 343 CR 312 330
C 301 C 346 C 309, 312—330
R 327 R 356 R 328—350
FIRST USED LAST USED OMITTED
REFERENCE DESIGNATIONS
SCHEMATIC— OUTPUT AMPLIFIER MODEL 109
40000-102

DATAPULSE
DIVISION OF DATAPULSE INCORPORATED

SERVICE BULLETIN NO. 1-65

SEMICONDUCTOR REPLACEMENTS

(Applicable to all Datapulse Models except the Model 100 & 102)

Datapulse makes extensive use of house labeled semiconductors, superseding or used in place of commercial equivalents. In most cases, these are procured against relaxed or actual commercial equivalent specifications, and commercial equivalents as listed below may, therefore, be used as replacements.

	DATAPULSE TYPE NO.*	DATAPULSE PART NO.	COMMERCIAL EQUIVALENT
Diodes:	DP16-0	22164-000	1N3600
	DP16-1	22164-001	1N3604
	DP19-0	22194-000	1N2070
	DP19-1	22194-001	1N4002
	DP19-6	22194-006	1N2071
Transistors:			
	DP43-0	22435-000	2N984
	DP46-1	22465-001	None**
	DP59-0	22595-000	2N1132A
	DP60-0	22605-000	2N2411
	DP60-1	22605-001	None**
	DP60-2	22605-002	2N2904
	DP60-3	22605-003	2N2894
	DP63-0	22635-000	2N2369 or 2N2501
	DP63-1	22635-001	None**
	DP63-2	22635-002	None**
	DP63-3	22635-003	2N2369A

*Some earlier publications show Type No. without the dash.

**DP46-1 is selected from 2N2964A for high Beta.
DP60-1 is selected from 2N2894 for high V_{eco}.
DP63-1 is selected from 2N2218 for second breakdown characteristics.
DP63-2 is selected from 2N914 for tighter Beta tolerance.

Replacements for these items should be procured from Datapulse.

WARRANTY

Datapulse Incorporated warrants each instrument of its manufacture to be free from defects in material and workmanship. Our obligation under this Warranty is limited to servicing or adjusting any instrument returned to our factory for that purpose, and to making good at our factory any part or parts thereof except tubes, transistors, fuses or batteries which shall, within one year after making delivery to the original purchaser, be returned to us with transportation charges prepaid, and which our examination shall disclose to our satisfaction to have been thus defective.

Instruments returned under this Warranty will not be accepted at the Datapulse plant without prior authorization by a Datapulse representative or by the service manager of Datapulse Incorporated.

Datapulse Incorporated reserves the right to make changes in design at any time without incurring any obligation to install same on units previously purchased.

This Warranty is expressly in lieu of all other obligations or liabilities on the part of Datapulse Incorporated and Datapulse Incorporated neither assumes nor authorizes any other person to assume for them any other liability in connection with the sales of Datapulse Incorporated instruments.

INSTRUMENT CERTIFICATION MODEL 109

Serial Number 030

1. Repetition Rate

   a. Internal

      Coverage: 4 cps to 40 Mc ✓

      Vernier: No Holes from 4 cps to 40 Mc ✓

      Accuracy: Full scale of each range is accurate to within ±20% ✓

   b. External

      Triggers from ±1.5v pulses 0 cps to 40 Mc ✓

      Triggers from 2v rms sine wave from 4 cps to 40 Mc ✓

      Single Pulse Pushbutton gives one cycle of output for each depression ✓

   c. Gated Operation

      Signals more positive than +3.5v ✓

      Block Output ✓

2. Sync Output

   Sync Amplitude greater than 2v into 50Ω from 4 cps to 40 Mc ✓

3. Pulse Delay

   Coverage: -10 nanosec to 50 ms ✓

   Vernier: No Holes ✓

   Accuracy: Full scale of each range is accurate within ±20% except -10 nanosec point ✓

4. Pulse Duration

   Coverage: 10 nanosec to 50 ms ✓

   Vernier: No Holes ✓

   Accuracy: Full scale of each range is accurate to ±20% except at 10 nanosec point ✓

5. Main Pulse Output

   Amplitude is 10v +20%, -5% ✓

   Positive Pulse ✓

   Negative Pulse ✓

   Transition Time

Transition Time

Leading Edge: Less than 5 nanosec ✓

Lagging Edge: Less than 5 nanosec ✓

Waveform abberations are less than ±5% at amplitudes greater than 3v ✓

Positive Pulse ✓

Negative Pulse ✓

6. Duty Cycle

a. Frequency: 40 Mc
Duty Cycle greater than 50% ✓

b. Frequency: 4 Mc
Duty Cycle greater than 75% ✓

7. Double Pulse Mode

a. Minimum separation between leading edges of first and second pulses is less than 25 nanosec ✓

b. Maximum variation in amplitude between first and second pulse at 10 nanosec pulse width and 25 nanosec delay is less than 10% ✓

I CERTIFY THAT THIS INSTRUMENT MEETS THE ABOVE SPECIFICATIONS

L R Lemieux
Test Inspector

6/2/65
Date

2 JUN 1965